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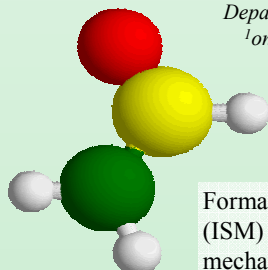


DISSOCIATIVE ELECTRON ATTACHMENT TO FORMAMIDE

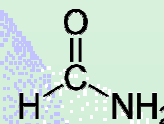


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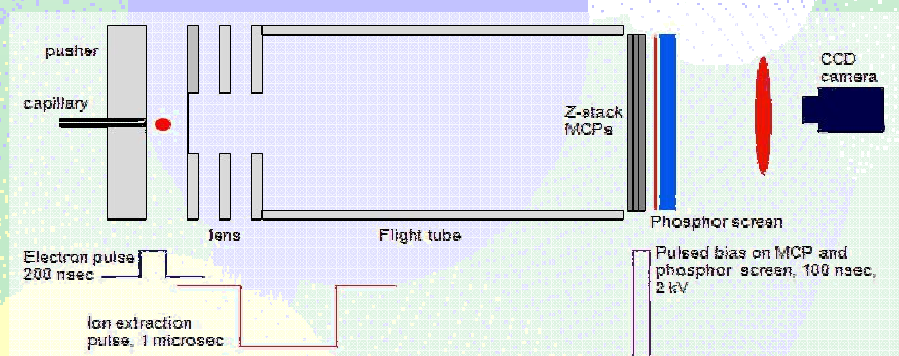
Why formamide?



Formamide is the smallest molecule with a peptide bond and has recently been observed in the interstellar medium (ISM) [1], suggesting that it may be ubiquitous in star-forming regions. Therefore there is considerable interest in the mechanisms by which this molecule may form and its role in the formation of larger biomolecules. One method for its formation is electron induced chemistry starting with dissociative electron attachment (DEA) within icy mantles on the surface of dust grains. The same process may lead to its fragmentation to form reactive radicals which then may form larger molecules. The interest in this molecule also arises from the functional group dependence property of DEA, which leads to site selective fragmentation of molecules at the C-H, O-H and N-H bonds at energies well below the direct impact threshold for the breaking of any of these bonds [2].

Experimental setup

We have used an improved version of a Velocity Map Imaging (VMI) spectrometer [3] comprised of a magnetically collimated and low energy pulsed electron gun, a Faraday cup (to measure the incident current), an effusive molecular beam, a pulsed field ion extraction, a time of flight analyzer and a two-dimensional position sensitive detector consisting of microchannel plates and a phosphor screen.



Results

We observe H- and another ion at mass 16, which could be O- or NH₂-. From the ion yield curve for H- (m=1) we observe two resonance peaks at electron energies of 6.3eV and 10.5eV respectively (Fig 1a). The ion yield curve for mass 16 show two broad resonance peaks at 5.8eV and 11eV (Fig 1b). In contrast the calculations of Goumans et al. [4] on DEA to formamide show resonances leading to NH₂ formation at 3.77eV and 14.9eV, however the appearance energies (AE) of O-/CHONH₂ and NH₂-/CHONH₂ were found to be 4.0eV and 3.5eV, respectively (calculated using a heats of formation [5]) and correlate with our results.

Velocity map images were measured close to resonance energy peaks for H- and mass 16 and are shown in Fig 2. The radius of the image represents the magnitude of the velocity of the ions with which they are formed. The images show distinct anisotropy in the angular distribution, which are yet to be analyzed.

The most probable kinetic energy of the mass 16 fragment from the image at 5.6eV (Fig 2c) is found to be 0.5eV, giving a total kinetic energy release of 0.79eV. The remaining excess energy is expected to be in the internal excitation of the fragments.

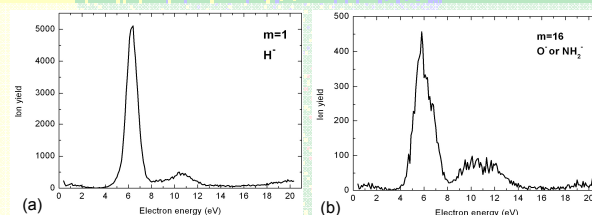


Figure 1. Ion yield curve for m=1(a) and m=16 (b) for 0 to 20eV of electron energy.

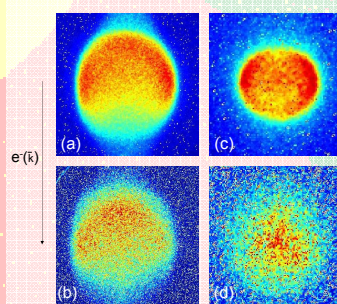


Figure 2. The VMI of negative ions from formamide. The electron beam direction is vertically down in the image plane.

- (a) H-/CHONH₂ at 6.0eV
- (b) H-/CHONH₂ at 11.0eV
- (c) O- or NH₂-/CHONH₂ at 5.6eV
- (d) O- or NH₂-/CHONH₂ at 10.6eV

Further work

Detailed analysis of the images to obtain angular distribution as well as kinetic energy distribution will be carried out. This is expected to provide information about the symmetry of the resonances as well as more insight into the molecular dynamics of low energy electron interactions with formamide.

References

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